REMARKS

Claims 1-28 are presented for examination in this application and subject to restriction. Applicant hereby elects to prosecute claims1-22 and claim 28. Claims 23-27 are withdrawn from consideration by the examiner.

Specification and drawings

Errors in specifying reference numbers are corrected in the amended specification paragraphs and the section defining the reference numbers. Reference number 34 is the substrate, 50 is the resistive trace, and the contact pads have been given number 52.

In line 11 of page 17, the word "good" was changed to "low" to more accurately reflect what is meant by "good thermal conductivity" and be consistent with the discussion in the previous sentence.

Correction of reference number 35 on Fig. 2c has been made to number 52.

No new matter has been added.

The word "plan" on pg 9, lines 6 and 28 is properly spelled.

The term "full hard stainless steel" as used on page 17 line 20 is a common term of reference for temper of steel, and in this case, specifically for stainless steel, and is not indefinite. Submitted herewith is an excerpt from a dictionary of steel industry terminology found at www.mesteel.com/dictionary. It shows the use of the term for various steels, including 301 stainless.

Claims

The independent claims 1 and 28 and several dependent claims were rejected under 35 U.S.C. 103 (a) as being on unpatentable over Juliano et al. in view of Riley. While Riley teaches a thick film circuit element having substrates and layers that are formed via silk-screening onto the surfaces of the substrate, Riley only discloses such an operation on flat substrates. Juliano actually teaches away from silk-screening circuit element on non-flat surfaces (column 4 lines 17-25). Because of this, and no teaching or suggestion in Riley of silk-screening on non-flat substrates, it would *not* have been obvious to one of ordinary skill in the art to modify Juliano with silk-screen printing of layers and materials for the elements as taught by Riley to produce silk-screened thick-film circuit elements on non-flat substrates. The prior art cannot be viewed with the benefit of hindsight afforded by the applicant's invention, which is the only disclosure of silk-screen printed circuit elements on a non-flat substrate.

Claim 1 has been amended to include the non-flat substrate limitation of claim 2. Claim 3 has been amended for proper dependency on claim 1. Claim 2 has been amended to recite the connector element of claim 1 in a dependent claim. Claims 10, 13, 14, and 22 have been amended for proper dependency on amended claim 2.

Claim 28 has been amended to broaden its scope, and the limitation of the connector moved to new dependent claim 29.

The amended claims now overcome examiner's 35 U.S.C. 103(a) rejection based on a combination of Juliano and Riley. All the other rejections of other dependent claims were also based on the combination of Juliano and Riley along with other patents. Since the amended independent claims overcome the combination of Juliano and Riley, the other dependent claims also overcome the rejections based on that combination.

The claims, as amended, now overcome the examiner's rejections, and the application, as amended, is now in condition for allowance.

Respectfully submitted,
Andrew Booth et al.

by

Steven J. Kotula
Reg. No. 41,911

Husky Injection Molding Systems, Inc.
288 North Road
Milton, VT 05468
802-859-8351 Customer # 24132

Application No.: 09/596,549

Title: THICK FILM HEATER APPARATUS
Inventor: Andrew Booth et al.
Filing Date: 06/19/2000
Docket No. H-525-0-US

Version with Marking to Show Changes Made

Specification section:

REFERENCE NUMERALS USED IN THE DRAWINGS

8 - hot runner nozzle assembly

10 - preferred embodiment

12 - heater assembly

14 - nozzle body

16 - channel

18 - connector sleeve assembly

20 - nozzle tip

22 - conductor

24 - slot

26 - dielectric layer

28 - resistive layer

30 - locating hole

32 - insulation layer

34 - [contact pads] <u>substrate</u>

35 - detent groove

36 - connector housing

37 - first contact groove

38 - locking detent assembly

39 - second contact groove

40 - contact

42 - key

44 detent pin

46 - detent spring

48 - low resistance conductive trace

50 - resistive trace

52 - contact pads

54 - passageway

56 - wound cable heater temperature profile

58 - copper sleeve heater temperature profile

60 - optimized computer temperature profile

62 - preferred embodiment temperature profile

Specification Paragraphs:

Pg 12 ln 18

Referring now to FIG. 2a, 2b, 2c, and FIG. 3, the heater assembly 12 is shown. The heater assembly 12 comprises an optional slot 24, a locating hole 30, a substrate 34, a thick-film dielectric layer 26, a thick-film resistive layer 28, at least a pair of contact pads [35]52 and an insulation layer 32. The heater assembly 12 comprises various layers of different materials. The substrate 34 in the preferred embodiment is a C-shaped piece of metal, typically made from steel or other thermally conductive material. The optional slot 24 runs the length of the heater and allows the substrate to act as a self clamping spring when installed around the nozzle body 14. In the preferred embodiment the substrate 34 is made from 430 stainless steel machined from solid bar or tube to have approximately 0.020″ to 0.040″ thick cylindrical wall.

Pg 16 ln 2

During the formation of the conductive trace 48, at least two contact pads [50]52 are formed from the same material. The contact pads [50]52 in the preferred embodiment are located at each end of the resistive layer 28 and provide a place to apply electrical power to the heater assembly 12. The contact pads [50]52 are located in a predetermined position on the heater assembly 12 for interface with the connector sleeve assembly 18 when the sleeve is fully installed and locked in place.

Pg 16 ln 10

Applied over the resistive layer 28 is the insulation layer 32 also using a silk-screen process. The insulation layer 28 is not applied over the contact pads [35]52. The insulation layer 32 is a mechanical, thermal and electrical insulative substance that protects the resistive layer 28 from abrasion and electrical shorts and reduces heat loss from the outside surface of the heater. The insulation layer 32 comprises a glass matrix which is fired at a temperature of approximately 600^0 C.

Pg 16, ln 26

The connector housing 36 is an annular shaped plug that will slidably engage the outside diameter of the heater assembly 12. A key 42 on the inside diameter of the housing 36 interfaces with the slot 24 and properly aligns the sleeve assembly 18 with the contact pads [35]52. The first and second contact grooves 37 and 39 are formed on the inside surface of the connector housing 36 for the insertion of spring contacts 40. The passageways 54 allow for the

installation of the conductors 22 through the wall of the housing 36 for connection to the contacts 40.

Pg 17 ln 5

The connector housing 36 in the preferred embodiment is made from a pressed and fired 96% dense alumina ceramic material. This material currently offers properties that are best suited for high temperature environments and exhibits electrical and thermal insulative properties. It could however be easily manufactured from any suitable material that possesses high dielectric properties and [good]<u>low</u> thermal conductivity.

Pg 17, ln 13

The connector housing 36 is an annular shaped plug that will slidably engage the outside diameter of the heater assembly 12. A key 42 on the inside diameter of the housing 36 interfaces with the slot 24 and properly aligns the sleeve assembly 18 with the contact pads [35]<u>52</u>. The first and second contact grooves 37 and 39 are formed on the inside surface of the connector housing 36 for the insertion of spring contacts 40. The passageways 54 allow for the installation of the conductors 22 through the wall of the housing 36 for connection to the contacts 40.

Pg 18 ln 2

Referring to FIG. 4, FIG. 5 and FIG. 8, the locking detent assembly 38 is shown. The detent assembly 38 is inserted in the detent groove 35. The detent groove 35 runs the length of the housing 36, and is wide enough to fully seat the detent assembly 38. The detent assembly 38 comprises a

detent spring 46 and a detent pin 44. When the housing 36 is installed on the heater assembly 12, the detent pin 44 is aligned and communicates with the locating hole 30. This alignment automatically occurs when the key 42 engages the slot 24 of the heater assembly 12. The detent spring 46 is made from a sheet material that exhibits spring like characteristics that can withstand the high temperatures of the molding process. In the preferred embodiment the detent spring 46 is made from type 301 stainless steel. As the connector sleeve assembly 18 is slid down the heater assembly 12, the detent pin 44 is sized to engage the locating hole 30 and effectively locks the connector sleeve assembly 18 onto the heater assembly 12 in the proper location and insures the alignment and communication of electrical current through the spring contacts 40 and the contact pads [35]52.

Claims:

1. (amended) [In an injection molding machine, a] A thick-film electric heater, comprising[,]:
   a) a thermally conductive non-flat substrate surface;
   b) a silk-screened dielectric layer applied on said substrate surface;
   c) a resistive layer applied on said dielectric layer thereby forming a circuit for the generation of heat;
   d) at least a pair of silk-screened contact pads applied in electrical communication with said resistive layer for electrical connection to a power source; and

e) an insulation layer applied over said resistive layer[; and

f) a connector housing for mechanical connection of a contact to each said contact pad, thereby eliminating the need for soldering, brazing or other phase altering connection means].

2. (amended) The heater of claim 1, [where said substrate is a non-flat surface] <u>further comprising a connector housing for connection of a contact to each of said contact pads</u>.

3. (amended) The heater of claim [2]<u>1</u>, where said non-flat surface is cylindrical.

10. (amended) The heater of claim [1]<u>2</u>, where said connector housing further comprises a locking detent that engages a locating hole on said substrate.

13. The heater of claim [1]<u>2</u>, where said connector housing further comprises a key for slidably engaging a longitudinal slot in said substrate, thereby aligning radially said contacts with said contact pads.

14. The heater of claim [1]<u>2</u>, where said connector housing is made from a ceramic material.

22. The heater of claim [1]<u>2</u>, where said contact is made from gold plated steel.

28. An injection mold runner nozzle having a co-axially disposed cylindrical heater comprising:

a) a cylindrical, thermally conductive substrate [with a slot running the entire length of said substrate, said substrate] having a smaller coefficient of thermal expansion than <u>that of</u> said nozzle, thereby causing said substrate to [further] clamp onto said nozzle as said nozzle and said substrate heat up;

b) a silk-screened dielectric layer applied on said substrate;

c) a resistive layer applied on said dielectric layer thereby forming an electrical circuit for heat generation;

d) at least a pair of silk-screened contact pads applied in electrical communication with said resistive layer for electrical connection to a power source; <u>and</u>

e) an insulation layer applied over said resistive layer[; and

f) an annular connector housing that slidably engages said substrate for mechanical connection of a contact to each said contact pad].

T

T-Bend 0-,1-,2-, etc.
A mechanical operation wherein a sheet sample is bent back upon itself with the inside bend radius specified in terms of the sheet thicknesses. Thus a 2-T Bend is a bend with an inside radius equivalent to two times the thickness of the metal sheet being tested.

Taconite
WHAT Natural mineral containing less than 30% iron. It is the primary ore used in blast furnaces.
WHY Domestic supplies of iron-rich ores (greater than 50% iron) were largely depleted in the 1940s, so integrated steel companies now process the lower-grade taconite to make it useful.

Tailored Blanks
A section of sheet or strip that is cut-to-length and trimmed to match specifications for the manufacturer's stamping design for a particular part. Because excess steel is cut away (to save shipping costs), all that remains for the stamper is to impart the three-dimensional shape with a die press (see Blanking).

Tandem Coating Line
A continuous coil coating line having two or more coating machines and curing or baking ovens in the line so it is capable of applying and curing two coats of paint in one pass through the line

Tandem Mill
A type of cold-rolling mill, the tandem mill imparts greater strength, a uniform and smoother surface, and reduced thickness to the steel sheet. Unlike the original single-stand mills, a tandem mill rolls steel through a series of rolls (generally three to five in a row) to achieve a desired thickness and surface quality.

Tapping
Transferring molten metal from melting furnace to ladle.

Tarnish
Surface discoloration on a metal, usually from a thin film of oxide or sulfide.

Teeming
Pouring molten metal from a ladle into ingot molds. The term applies particularly to the specific operation of pouring either iron or steel into ingot molds.

Temper
(1) In heat treatment, re-heating hardened steel or hardened steel or hardened cast iron to some temperature below the eutectoid temperature for the purpose of decreasing the hardness and increasing the toughness. The process also is sometimes applied to normalized steel. (2) In tool steels, temper is sometimes used, but inadvisedly, to denote the carbon content. (3) In nonferrous alloys and in some ferrous alloys (steels that cannot be hardened by heat treatment), the hardness and strength produced by mechanical or thermal treatment, or both, and characterized by a certain structure, mechanical properties, or reduction in area during cold working.

Temper
The state of or condition of a metal as to its hardness or toughness produced by either thermal treatment or heat treatment and quench or cold working or a combination of same in order to bring the metal to its specified consistency. Each branch of the metal producing industry has developed its own system of temper designates. In flat rolled products including sheet and strip steel, tin mill products, stainless strip, aluminum sheet and copper base alloy strip; they are shown as follows:

ALUMINUM SHEET - (See Aluminum)

COPPER BASE ALLOYS (Cold Rolled) - B S Gage Numbers.

NOTE - Hardness is indicated condition while hardness varies with alloy changes.

Temper . . . . *Hardness*

Annealed ....Commercially Soft

Quarter Hard ....One Number Hard

Half Hard ....Two Numbers Hard

Hard Temper ....Four Numbers Hard

Extra Hard ....Six Numbers Hard

Spring Temper ....Eight Numbers Hard

Extra Spring Temper ....Ten Numbers Hard

SHEET STEEL (Low Carbon Cold Rolled) - Temper Classifications.

Temper . . . .*Rockwell*

Full Hard . ... .069 and thinner B 90 min.

.... .070 and thinner B 84 min.

Half Hard .... Approx. R/B 70/85

Quarter Hard .... Approx. R/B 60/75

Soft Commercial Quality .... Approx. R/B 66 max.

Drawing Quality .... Approx. R/B 55 max.

STAINLESS STRIP STEEL (Cold Rolled Temper Classification) - Type 301.

NOTE - The various stainless strip tempers are based on specified minimum values for tensile strength or yield strength or both. However, because of custom, both distributors and customers alike rely on approximate Rockwell readings for temper classification. To illustrate:

Temper (Type 301) . . . . *Rockwell* . . . . *Tensile Psi*

Soft .... Approx. B 75/85 .... 110,000 Min.

Quarter Hard .... Approx. C 25/30 .... 125,000 Min.

Half Hard .... Approx. C 30/35 .... 150,000 Min.

Three Quarters Hard .... Approx. C 35/40 .... 175,000 Min.

Full Hard .... Approx. C 40/45 .... 185,000 Min.

Extra Hard (Type 301) .... Approx. C 45 min .... 200,000 Min.

Type 430 Soft .... Approx. B 75/85 .... 75/85,000

STRIP STEEL (Low Carbon Cold Rolled) - Temper Classifications.

Temper	*Rockwell*	*Means Tensile*
No. 1 Full Hard	.069 and thinner B 90 min.	80,000
	.070 and thicker B 84 min.	80,000
No.2 Half hard	B 70/85	64,000
No.3 Quarter Hard	B 60/75	54,000
No.4 Skin Rolled	B 65 max.	48,000
No. 5 Dead Soft	B 55 max.	

TEMPERED SPRING STEELS (Strip) - Temper indication is to Rockwell Hardness only.

TIN MILL PRODUCTS (Steel) Temper Classifications - NOT STANDARDIZED. FOR INFORMATION ONLY. (Not to be confused with the Cold Rolled Strip Steel Temper Numbering System wherein No. 1 Temper indicates Full Hard, while in the TIN MILL Product Numbering System No. 1 Temper indicates a soft condition.) The following Rockwell ranges are approx. only.

Temper-Number	*Rockwell - 30 T Scale*	*Rockwell B Scale*
No. 1 Temper	Aim at 46/52	Aim at 45/53
No. 2 Temper	Aim at 50/56	Aim at 51/59
No. 21/2 Temper	Aim at 52/58	Aim at 53/62
No. 3 Temper	Aim at 54/60	Aim at 56/66
No.4 Temper	Aim at 58/64	Aim at 62/71
*No. 5 Temper	Aim at 62/68	Aim at 68/77
*No. 6 Temper	Aim at 62/73	Aim at 75/84

*NOTE: Tempers 5 and 6 are temper rolled from rephosphorized steel in order to develop desired hardness and stiffness. The above temper classifications are used principally by producing mills and can manufacture but are not in general use in the sheet and strip industry.

Tension Leveling
A mechanical operation wherein steel sheet, in coil form, is processed on a unit that stretches the product beyond its yield point to impart permanent deformation. The stretching operation assists to flatten the sheet. Tension leveling is considered the optimum process to achieve superior flatness characteristics.

Telescoping
Transverse slipping of successive layers of a coil so that the edge of the coil is conical rather than flat.

Temper Brittleness
A reversible increase in the ductile-brittle transition temperature in steels heated in, or slowly cooled through, the temperature range from about 700 to 1100 F (375 to 575 C).